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ABSTRACT

The first session of IT@EDU98 consisted of four papers and was chaired by Dong Thi Bich Thuy (University of Natural Sciences, Ho Chi Minh City, Vietnam). "Technology for Learning: The Present and Future in the United States" (Thomas Owens, Carolyn Cohen) focuses on how technology is changing learning, looks at the most promising opportunities as well as concerns, and describes implications for the use of technology in improving educational outcomes. "Computer Systems Technology Programs at the British Columbia Institute of Technology (Canada). A Technology-Based Model for Information Technology" (Ken Takagaki) describes the underlying concepts of the diploma and technology program models, investigates how they result in distinct and viable job entry and career advancement credentials, and suggests how the programs should evolve to keep pace with rapid changes in technology in this high technology and software industry. "Using the World Wide Web in Education and Training" (James Kow Kim Song) looks at using the World Wide Web for distance education and describes "Informatics1" an Internet online service for learners that provides an interactive environment including video conferencing, automated online tests, mock exams, educational resources, chat rooms for group discussions and other technology. The text of the third paper, "The University Level Training Program of the Information Technology" (Phan Dinh Dieu) is not included. (SWC)

SESSION 1

Thursday, 15 January 1998

Session 1: Keynote address

Chair:
Dr. Dong Thi Bich Thuy, University of Natural Sciences, HCMC, Vietnam

1-1. **Technology for learning: The present and future in the United States**
Dr. Thomas Owens, Carolyn Cohen, NWREL, USA

1-2. **Computer systems technology programs at the British Columbia Institute of Technology (Canada). A technology-based model for Information Technology**
Dr. Ken Takagaki, BCIT, Canada

1-3. **The University Level Training program of the Information Technology**
Prof. Phan Dinh Dieu, HNU, Vietnam

1-4. **Using the World Wide Web in Education and Training**
Mr.James Kows, Informatics College, Singapore

TECHNOLOGY FOR LEARNING:
The Present and Future in the United States

Thomas Owens, Carolyn Cohen
Northwest Regional Educational Laboratory, USA

"I suspect that we fail to recognize the real depth and breadth of the ongoing and potential impact of technological change on learning in America."

Participant Larry Frase, Research Director
Educational Testing Service

"Technology should be infused into curriculum so it is like a latte. It can't be just integrated; it has to become a whole different flavor and look with the coffee and milk inseparable."

Participant Cathy Parise, Technology Supervisor
Office of Superintendent of Public Instruction, state of Washington

On August 11, 1997, a group of 28 futurists from the Northwestern part of the United States congregated for a three-day meeting in Oregon. Ourpurpose was to learn from each other and to expand our thinking on the implications of technology for learning. Our group included business people, educational policymakers, teachers and administrators in the K-12 system, and representatives of higher education. This conference was sponsored by the Education and Work Program of the Northwest Regional Educational Laboratory (NWREL).

During the three days, we rotated through small and large discussion groups to address these questions:

- How do we learn? What strategies work best in teaching and learning?
- What are the current uses of technology in learning? What will they be in the next 30 years?
- What are the issues and opportunities in the use of technology for learning and teaching?
- How do we go about creating a preferred future for learners?

In this paper we focus on how technology is changing learning; the most promising opportunities as well as our concerns; and describe implications for the use of technology in improving educational outcomes. Input for this paper came from the collective thinking of the participants at the NWREL conference and experiences we have had regarding technology and learning over the past 20 or more years.

How Will Technology Change Learning?

"We always underestimate the long-term impact of new technologies. When radio first came out, they just read the newspaper to us on the radio; when television came out, the first shows were basically adapted radio shows," noted participant Neil Evans, Executive Director, Northwest Center for Emerging Technology. As a group, we tried to envision education outside the parameters of our current way of thinking. We talked about the learning implications of simulations, artificial intelligence, access to on-line experts, and distance learning. We also

noted that technology doesn't just mean computers, but also includes laboratory science equipment, video, and other media tools. We identified seven broad areas where we have already seen technology change education. We expect further evolutions in each of these areas.

1. **Use of technology is changing both student and teacher roles.** Students will take more responsibility for their own learning. The teacher will facilitate the learning process, rather than serving as the sole source of information. This step is critical in preparing students for the workplace, where they will need to be skilled in seeking out answers and solving problems. However, teachers will still need to be well-grounded in subject areas. Also, technology will provide more opportunities for individualized instruction, and allow students to learn at their own pace and in various locations.

2. **Students will access information in new ways.** Participant Myrtle Mitchell, dean at Seattle Central Community College, pointed out that use of information will, in many cases, supplant textbooks. She gave the example of information from the recent Mars exploration, which was beamed back every eight minutes and available to anyone with Internet access. Science information that is current will, of course, never be available in classroom textbooks. So, for certain areas, there will be more reliance on alternative ways of gathering information. Also, learners can access information without the constraints of time or place: there is no waiting for materials to be checked in or for the library to be open.

3. **More students, and those of all ages, will fully participate in the learning community.** We anticipate expanding opportunities for many students who have not been fully served by education systems. For example, a community college administrator related how deaf students can participate in courses and communicate with faculty without relying on signing and interpreters. Another example is that adult learners who are balancing work, school, and family will be able to use technologies such as distance learning to participate in courses at times convenient for them.

4. **Students will work together with their communities in new ways.** For example, students can collaborate on projects with students and/or faculty at other schools

anywhere in the world. They can also work with community members, such as the model piloted by the Hewlit-Packard company that allows employees to mentor students through on-line communication.

5. **Teachers will use technology to improve efficiency.** We have seen several examples of teachers using e-mail and the Internet to conduct assessment and tracking, communicate with students, and provide syllabi and resources, all on-line. Another benefit of this technology is that students can access some resources on their own that they are used to getting from teachers or counselors. For example, students seeking career guidance can get information on-line. One high school teacher noted that this capability is a significant improvement in his school where, because the school counselor/ student ratio is 400:1, students find it difficult to meet with their counselor. This teacher also cautioned that while teachers must use technology effectively as a tool, it does not replace the interpersonal connections that are critical to a learning experience, and does not replace the role of personal interaction at the K-12 level in developing young people as responsible citizens.

6. **Institutions of learning will restructure.** Technology provides schools with restructuring opportunities. In fact, the very idea of a "school building" may change. We expect to see "colleges without walls," and accreditation of on-line programs. In the near future, colleges may become the brokers of courses and teachers, reaching and competing for students regardless of boundaries. As one community college administrator said, "Our students will be the world." This restructuring would have a profound policy impact, particularly if the outcome is the demise of state-based or nation-based college boundaries. If that happens, colleges will need to employ new strategies to compete for students across the globe, and policy makers will need to rethink state financing of higher education.

7. **Schools will have new opportunities to serve parents and communities.** Large segments of the adult population who did not grow up using computers and other technology are eager for access and instruction. This provides an opportunity for schools to share equipment and instructional expertise with their community, and to provide family learning. For example, some schools have implemented programs that provide computer courses for parents and community members in the evenings, or weekend opportunities where families learn together. Others offer families on-line opportunities to access information about curriculum, homework assignments, and student progress. In a recent visit to one inner city high school in Seattle we talked with a Hispanic student who came to school early every morning to use the Internet to download the Spanish language newspaper to copy articles for his family to read that evening at home.

Challenges All of the opportunities cited above have multiple consequences. The NWREL conference participants were selected because of their interest and involvement in the world of education and technology. We see the use of technology as a powerful learning tool, whose potential even the most technically knowledgeable of us may barely perceive. However, we did not all agree with each other on several issues. We debated where technology funding fits in as an educational priority, and some of us expressed other concerns that are described below. These concerns are not over the importance of using technology; they are, rather, issues that are raised by many educators and can be thoughtfully addressed by those concerned with education policy.

Equity Issues. For example, technology has the potential to provide an opportunity for more equal access to educational experiences, particularly for those who are educationally disadvantaged. At the same time, if access to technology is dependent on factors such as social class, the gulf between the "haves" and the "have nots" will increase. Appropriate use of technology to further educational outcomes. One community college faculty member warned, "Don't embrace technology just for its own sake. As with any instructional strategy, teachers must be clear about their learning objectives, and then evaluate whether, and which use of, technology enhances those objectives."

School funding priorities. Participants reviewed an article published in a recent copy of the Atlantic Monthly, "The Computer Delusion." The author raises concerns over expenditures on computers at the expense of other educationally sound programs and questions the learning outcomes of classroom computer use. In our discussions, concern was voiced over funding priorities in general, particularly regarding the decline in funding for art and music. Some noted that we know that art and music, which have been significantly cut in many public schools, have great developmental value if taught early. We don't know if the same is true for technology.

Faculty/staff support. Effective technology implementation requires significant staff support. Faculty and staff should be provided ample training, with home access to technology and time to learn. Such training has to be related to ways of improving curriculum and instruction and to the existing knowledge level of individual teachers.

Internet literacy training. Some participants were concerned over youth having access to pornography, violence, and other inappropriate materials. These participants were also concerned about the "garbage" and misinformation on the Web that is portrayed in very credible ways. Students at all grade levels will need to be taught specific skills in assessing and evaluating information.

Ethical issues/Student Privacy. Technological changes are occurring faster than our ability to think ethically about their consequences. Every day we read about new developments, such as the ability to clone, prolong or end life with medical equipment, and access others' personal health and financial records. These changes will be part of our students' lives, and they will be the ones making ethical decisions about how to develop and use these capabilities. As a result, we must keep our focus on the essentials of learning: critical thinking and problem solving, character development, and understanding one's rights and responsibilities as a citizen must be the building blocks of education. Some participants voiced concerns that access to student data be safeguarded, and privacy maintained.

Developing Our Preferred Future. Schools face many complicated issues when determining how best to infuse technology into education. Several participants noted that we need more solid research on where technology is best used. We need information on how using technology for learning affects the development of cognitive strategies. We want to maintain the fundamental principles of education, which one participant defined as "civility, intelligence, and humanness, and another added "creativity, and passion." We want to see technology as a tool, but not necessarily as its own subject. For example, we would expect spreadsheets to be incorporated appropriately into existing coursework, rather than a class taught in using spreadsheets. Implications for Education and Training . The issues raised and debated in this NWREL conference are of concern to the education and business communities across the country (and perhaps the world). As evidence, nearly all of the challenges we identified are also noted in the recent publication Plugging In: Choosing and Using Educational Technology, published by the Council for Educational Development and Research of the North Central Regional Educational Laboratory. This document identifies the need for equity of access for all students and all schools; teacher support and professional development; high standards for student achievement; new solutions in school finance; integration of technology curriculum with other subjects particularly school-to-work; and working in partnership with the parent community. A few of the implications are listed below: How do we build on existing and develop new education-business partnerships so that we can work together to bring the best learning opportunities to our students, workers, and citizens? Many states in the United States are emphasizing comprehensive school reform efforts including statewide standards setting, testing, and evaluation. How will we incorporate technological literacy into these standards? How will we use technology to improve learning for all? As more and more schools are using technology in their classrooms, we need to find ways to identify best practices in infusing technology into education and disseminate such practices worldwide. Staff development is a key in using technology effectively in our classrooms. We found teachers in many schools encountered similar problems in use of technology in classrooms. There need exists to proved, through existing or new technologies, staff development which are accessible to more teachers, particularly those in remote or rural areas.

Access to technology increases the volume and flow of information. Our students, teachers and business members are often inundated with information. To help people use critical thinking skills to make a sound judgment based on relevant information will remain a challenge to all of us.

COMPUTER SYSTEMS TECHNOLOGY PROGRAMS AT THE BRITISH COLUMBIA INSTITUTE OF TECHNOLOGY (CANADA) A TECHNOLOGY-BASED MODEL FOR INFORMATION TECHNOLOGY TRAINING

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Abstract

The High Technology and Software sectors in British Columbia are among the fastest growing in the provincial economy and must be supported by an effective educational and training system in order to maintain and increase their presence in the global IT economy. The current system in B.C. consists of three major components: traditional degree programs in Computer Science offered by the universities, two-year diploma programs in Computing Technology offered through regional community colleges, and the diploma and technology degree programs offered by the British Columbia Institute of Technology (BCIT). Graduates of the two-year Diploma programs are well accepted by high technology employers and in some cases, even preferred to graduates from traditional degree programs. BCIT pioneered many of the concepts underlying the Diploma and Technology Degree models. This paper describes some of these underlying concepts and how they result in distinct and viable job entry and career advancement credentials. The paper concludes with some comments how these programs are expected to evolve in order to keep pace with the rapid changes in technology faced by this industry.

Introduction

The High Technology sector in British Columbia is one of the fastest growing in the province and a focus of increasing interest for government economic policy and private investment. In 1995, the last year for which complete statistics have been gathered [1], this sector earned in excess of CDN $5.1 billion with an annual growth of well over 30% compared to a 5% overall growth in the British Columbia Gross Domestic Product. There are some 5,500 high technology companies in the province and this number is steadily growing by about 10% per year. In 1995, direct employment in this sector was about 41,000 workers in 1995 with a growth rate of 20-25% per year. By comparison, the total provincial workforce grew 4% during this period. In addition, there are significant numbers of programmers, systems analysts and other Information Technology-related staff employed by firms in the other industry sectors of the province. With respect to employment related specifically to Software Technology, there are approximately 21,000 software workers and professionals in B.C. [2] most of whom are trained at the post-secondary level in computer science, programming and software engineering.

The B.C. software industry is now participating in the global high technology economy and the rapid growth in this sector has created enormous opportunities. As in many other parts of the world, however, B.C. also faces a chronic shortage of qualified software technology workers. Recent estimates suggest that in 1996, 5-7% of the required software positions in B.C. remain unfilled [2], thus hampering the potential growth in this industry sector. Thus, the province is faced with some major challenges in supplying a well-trained, highly motivated, and effective workforce to ensure the ongoing success and well being of its software industry.

Over the years, British Columbia has been evolving a sophisticated and effective public educational system to support this industry sector with world class human resources and to provide opportunities for the many thousands of men and women interested in seeking careers in the software industry. Through provincial legislation, this system is divided into three major components: (1) the *Universities* offering Bachelor, Masters and Ph.D. programs in Computer Science; (2) regional *Community* or *University Colleges* offering two year Diploma and one year Certificate programs; and (3) the *Institutes*, specifically the *British Columbia Institute of Technology* offering Bachelor of Technology, Diploma and Certificate programs.

Altogether, this system delivers annually some 600-700 graduates with the appropriate post-secondary training necessary (i.e. at degree or diploma levels) to effectively enter this industry [Table 1]. Graduates from two-year Diploma programs are well accepted by the B.C. high technology and software industry and, in some cases, preferred to more traditional four-year degree programs. The B.C. Institute of Technology (BCIT) originally pioneered the concept of the two-year Diploma program in Computer Technology as a distinct and viable alternative to university degree programs for both employers and for students seeking training options. More recently, BCIT also pioneered the concept of the technology degree, the *Bachelor of Technology*, which effectively builds upon Diploma programs and offers professional development and career advancement opportunities to IT practitioners.

	Graduates (1995/96)
Degree Programs	294
Diploma Programs	298
Certificate and Others	101

Table 1. Graduates from Job Entry level programs [3]
(Undergraduate degree and diploma programs)

BCIT – A Technology-Based Training Institute

1. The B.C. Institute of Technology

BCIT is a publicly supported post-secondary Institute established by provincial legislation to provide technological training programs to support the industry sectors important to the B.C. economy [4]. As such, BCIT offers one year (or less) Certificate Level, 2 year Diploma Level, and 4 year Bachelor level programs related to Business, Engineering and Health. In addition, BCIT has mandates to pursue applied research and to facilitate and encourage entrepreneurial activities. BCIT also has one of the largest Part Time Studies and Continuing Education programs in the province with courses and programs designed specially for individuals already working in industry and wishing to upgrade and advance their careers.

BCIT is located over several campuses including the main campus in Burnaby B.C., a campus in downtown Vancouver, an Airport Campus, and the Pacific Marine Campus in North Vancouver.

2. School of Computing and Information Technology

BCIT has established a School of Computing and Information Technology offering a variety of programs in Computer Programming, Systems Analysis and Software Development. The School is composed of three major program areas: Diploma Programs, Continuing Education and Professional Programs, and the Bachelor of Technology Program.

The Diploma programs are two-year programs with a total enrolment of 400 students per year, 200 in 1st Year and 200 in 2nd Year. These are designed as *job entry* programs into the Computing industry. The majority of applicants to the program are individuals from the workforce who are seeking a major career change. The remaining are equally divided into direct applicants from the High School system and applicants with degrees or other post-secondary credentials seeking entry into the computing field.

The Continuing Education and Professional programs provide training to over 6,000 students per year in over 500 different courses, mainly to individuals who are already working and wish to enhance their existing skills or advance their careers. The level of this training ranges widely, from introductory courses in computer literacy to very advanced and highly specialized and technical topics. Often, these courses can be packaged as specialized Certificate programs in focused areas such as Office Automation, Network Administration, or Internet Support.

The Bachelor of Technology program provides advanced, degree level training to students who already possess a job entry qualification such as the 2 year Diploma or in some cases, a conventional university degree. This program is designed specifically to meet the needs of individuals already employed in the IT industry and is offered primarily in evenings, weekends or in other formats which provides full-time employees access to this type of ongoing education.

In addition, the School offers many professional seminars, short programs, customized training and other products as the demand arises.

Curriculum Design

The overall curriculum design for the *Computer Systems Technology (CST)* Diploma program is shown in Table 2 and the *Bachelor of Computer Systems Technology* Degree program in Table 3.

1. Diploma Program

	Term 1	Term 2	Term 3	Term 4
Communication Skills	• Technical Writing & Speaking	• Technical Writing & Speaking		
Mathematics	• Applied & Discrete Math	• Statistics	• Decision Systems	
Business	• Economics • Accounting	• Marketing • Accounting	• Org Behavior	• Computer Law
Programming	• Programming Methodology • C Language	• Visual Programming • C++/JAVA	• Advanced C++/JAVA	• O-O Design
Systems	• Computer Applications	• Systems Analysis & Design		• Software Engineering & CASE
Technical		• Computer Architecture	• Data Base • Data Comm	• Advanced Op Sys
Project Work			• Industry project	• Industry project
Specialization			• 2 Specialty Courses	• 2 Specialty Courses

Table 2. Two-Year CST Diploma Program – Curriculum Map

As can be seen from the Curriculum Map, all students receive courses in the three foundation areas: Communication Skills, Mathematics and Business. This provides students with basic employability and business context skills. All students are required to take Programming, Systems and Technical courses to an advanced level. Industry projects are also required of all students in their third and fourth terms. These projects are sponsored by local firms and organizations and are considered a major "capstone" experience for the students.

A unique feature of the BCIT CST Diploma program is the ability for students to major in one of several specializations, each of which are targeted to a specific market segment. These specialties will vary according to trends in industry. Currently, these specializations include:

- Applied Artificial Intelligence (Expert Systems)
- Data Communications & Networking
- Data Base
- Technical Programming
- Client-Server Systems
- Multi-Media Software Development
- Management Information Systems.

Students take the equivalent of 4 courses in their specialization area.

The program puts a heavy emphasis on teamwork, communications and other employability skills. While much of the curriculum is delivered by conventional lectures, lab assignments, and examinations, a very substantial percentage of the students' learning, often 50% or more, is based upon group projects and teamwork activity. The curriculum also provides many opportunities to interact with industry and potential users through industry sponsored projects, guest lectures, and special arrangements with numerous vendors and suppliers of hardware and software.

Altogether, graduates of the BCIT Diploma program receive a total of about 2400 hours of in-class instruction during their studies or about 1200 hours per year. This can be compared to the 450 to 750 hours of classroom instruction per year found in typical undergraduate university programs. This is accomplished by an extended school year (average 17 weeks per term) and 7 hours of classes over 5 days each week. There are no general education or liberal arts requirements and students are able to focus solely on curriculum related to employability in the IT industry.

2. Bachelor of Technology

The Bachelor of Technology is a practitioner-oriented degree program specifically designed for the career enhancement and professional development of individuals already working in the software industry. As such, the prerequisite to the program is the BCIT CST Diploma or its equivalent, as well as two years of relevant work experience.

As can be seen from Table 3, the curriculum is structured into four major components: core courses, technical courses, a formal practicum, and a liberal education requirement.

The core courses are designed to give students exposure to advanced issues in the management and technology relevant to intermediate and senior IT practitioners. These courses are also designed to help develop the management maturity and critical thinking skills of students.

The technical courses are designed to permit substantial depth in an area of the student's choice.

The practicum is a project or other activity, preferably in a workplace setting that involves applied research or technology transfer and produces an outcome that is innovative, experimental or exploratory in nature. A formal process for project proposal, defining formal deliverables, and presenting the final report is required. The practicum is supervised and reviewed by a formal review committee consisting of academics and industry representatives. In most cases, the practicum emanates from a major project or assignment in the student's workplace.

The liberal education component requires courses in Arts, Social Sciences, History, Language Studies or other areas unrelated to the computing field. This constitutes the breadth component of the degree.

As indicated in the Curriculum Map, the degree requires 60 credits of work. Most courses in the degree program are offered in evenings and weekends, making them accessible to working professionals with full-time jobs. Candidates have considerably flexibility in how they progress through the program but are required to maintain a minimum load of 3 courses per year. All candidates are required to complete the program within 6 years.

Degree Component	Admission to Program	Level 1	Level 2	Before Graduation
Prerequisite	BCIT CST Diploma or equivalent			
Work Experience	2 years related experience			
Core Courses (15 Credits)		• Management issues in IT • Technical issues in IT • Applied Research Methods • Advanced Management Electives		

Advanced Technical Specialties (15 Credits)			• Data Base • Data Comm • Computer Graphics • AI • Electives	
Practicum (18 Credits)			• Major formal practicum	
Liberal Education (12 Credits)				• 12 University Credits in approved courses

Table 3. CST Bachelor of Technology– Curriculum Map

Non-Curriculum

1. Faculty

The minimum standard for regularized faculty is Master's degree in Computing Science or related field and 5 years significant industry experience. Since these programs are heavily career-oriented, faculty are expected to maintain industry currency and professional contacts within the profession.

2. Facilities

These programs are supported by a variety of hardware and software resources. They include an IBM mainframe, SUN and SGI UNIX systems, and some 30-40 networked PC labs under Novell and Windows NT.

3. Advisory Committee and Industry & Academic Liaison

Both the Diploma and Degree programs are supported by an Advisory Committee consisting of senior managers, executives, and officials representing different industry segments including large corporations, major consulting firms, high technology companies, independent software developers, and academics. In addition, faculty and student involvement with local, provincial, national and international industry and professional organizations are encouraged. The programs are, where appropriate, accredited by relevant industry accrediting bodies (in Canada, this is the *Canadian Information Processing Society*).

4. Student Recruitment & Job Placement

While the B.C. post-secondary system allows open access to all qualified applicants, every effort made to ensure candidates make appropriate career choices and are highly motivated to complete the program. There is a heavy emphasis on student recruitment activities such as detailed orientation sessions for applicants, aptitude testing, and career counseling.

Graduates from this program have traditionally shown excellent job placement rates. Follow-up surveys indicate that around 95% of graduates from the Diploma find employment within 3 months of graduation.

5. Applied Research

Teaching faculty do not have a research requirement as part of their duties. However, opportunities for conducting applied research are available through a separate department at BCIT, the Technology Centre, that has the mandate for applied research. A special research division, the Applied Research in Computer Systems (ARCS) Laboratory specializes in computing and IT applied research projects.

Summary

Table 4 attempts to summarize some possible differences between the BCIT and typical Computer Science degree programs. It is difficult to generalize, however, since there is much variation between the Computer Science undergraduate degree programs offered through difference universities.

Program Component	BCIT Approach	Computer Science Degree Approach
Employability	• Team work skills • Technical Writing, Speaking and Communications skills • Industry related Project experience required for graduation	• Some universities offer Co-Op programs
Overall Curriculum	• Two step credentials (Diploma for job entry, Degree for Career Enhancement) • No liberal arts or general education requirement in Diploma programs, graduation requirement for Degree • Applied mathematics only (Discrete Math foundations, Statistics, Decision Systems) • Formalisms only as required	• One step credential • Liberal art and general education typically satisfied early in program • Emphasis on mathematics topics • Formalisms often required in program
Domain Knowledge	• Business foundations (Accounting, Marketing,	• Normally not part of typical CS degrees (except for

	Economics, Organizational Behaviour, Computer Law)	combined CS/Commerce degrees)
Programming	• Exclusive use of industry standard languages, otherwise similar to University programs	• Teaching languages are often used
Systems	• Emphasis on industry practice, especially practical issues (user interfacing, interview techniques, expectations management, end-user training, etc)	• Often more emphasis on Software Engineering and formal techniques
Technical Topics	• Heavy emphasis on applications and industry-specific products, otherwise similar to University Programs	• Less emphasis on product-specific applications

Table 4 : BCIT and Computer Science Curricula

It is usually acknowledged that the BCIT programs are specifically designed for employment into the workforce or for upgrading the skills of workers already employed in the industry. Unlike Computer Science programs, the curriculum has no provisions for leading to careers in academic research or typical graduate programs in Computer Science. The BCIT curriculum contains less mathematics and formal theory. On the other hand, it puts significantly more stress on employability skills, product-specific knowledge and practical issues (e.g. interfacing with users and managing user expectations).

Future Issues

As a primarily practitioner-oriented training and educational organization, the School of Computing and Information Technology puts a premium on its ability to respond quickly and effectively to technology trends and new product releases. Major curriculum changes in the diploma program have been implemented in as little as three months or less through an on-going and continuous curriculum review process. In the future, mid-term and "on-the-fly" response cycles of as little as 2-3 weeks to rapid changes in technology may be needed.

Trend	Planned Response	Examples
Increasing consumerization and diversity in the IT sector. Demand for more cross-trained and multi-skilled individuals. Skills gaps in project management, marketing & distribution,	Wide diversity in programming, including new specializations, cross-disciplinary programs, and partnerships with other private and public organizations	• Joint CST/Marketing Diploma • Joint CST/EE Diploma • Collaborative Multi-Media Diploma with Emily Carr (BC Art Institute) • New specializations e.g.

and leadership.		Games programming Internet
Shortage of qualified IT workers – short term	Encourage increased support in this industry sector from government. Seek alternatives to public funding. Explore alternate training formats as well as mentorship, job incubation, and work experience programs	• Cost-recovery programs in specific areas as specified by industry (e.g. Microsoft and Novell) • More short certificate programs in specific areas (e.g. LAN Admin, Windows NT support, etc) • Student projects under paid work conditions
Shortage of qualified IT workers – longer term	Provide special programs and improved access to new and under-represented learner groups	• Special programs for women, immigrants, and talented high school graduates • Provide special cross-training programs for individuals qualified in other fields (business, engineering, health) • Formally recognize prior training and work experience toward credentials

Table 5. Future Trends and Responses

In the near term, the School has identified a number of overall trends and developed some possible responses to these trends. A brief summary of these is presented in Table 5. The School also constantly monitors industry change, both through its own industry and market surveys and by reference to government and industry surveys and statistics.

Trend	Planned Response	Examples
Growing importance of industry specific credentials for job entry and career development (e.g. Microsoft and Novell certificates)	Curriculum designs permitting the co-existence of private and traditional academic credentials. Articulation, bridging	• Cost-recovery programs in specific areas as specified by industry (e.g. Microsoft and Novell) • Embed private credential opportunities within Diploma

	and laddering among the two sets of credentials.	and Degree programs • Recognize private credentials as prerequisites to programs or equivalents to conventional courses
Internationalization of IT industry	Develop international oriented programs	• Pacific Rim Computing Diploma/Degree • NAFTA Computing Diploma/Degree • Programs designed for immigrants to Canada • Articulation, exchanges and other collaborations with foreign universities
Growing complexity and specialization of IT industry	Increased use of Educational Technology and Internet-based resources. Increase resources for competency *assessment* (relative to conventional curriculum *delivery*)	• Web-based curriculum support • Computer-Based Training • Use of vendor-supplied tutorials and training materials

Table 5. Future Trends and Responses – cont'd

Table 6 summarizes some specific generally acknowledged issues, technology needs and skills gaps which are factored into the program design of the School [2]. Speaking very broadly, the following overall factors are likely to heavily influence the directions of future programs.

Increased consumerization and diversification of the IT industry. As this industry evolves and matures, it will demand increasingly more diverse skill sets, talents and aptitudes within its workforce. This is both a challenge to academic institutions and an opportunity for many new learner groups to enter and benefit from employment in this industry.

Critical skill gaps in both technical and non-technical areas. These include skills shortages in project management, marketing and distribution, leadership and administration. There is increasing attention to the concept that software development is very labour intensive and that the optimization of human resources is a necessity. Thus, the balance between technical and non-technical components is a significant challenge in human resource planning for this industry, *Worldwide worker shortages in IT.* The skills and worker shortages in this industry have been widely documented. In British Columbia, however, as in many other parts of Canada and the U.S., public funding for post-secondary education is not keeping pace with the training need. In addition, academic institutions are also suffering from a shortage of qualified faculty to teach and conduct research programs. In the long term, there is also a need to encourage more individuals with the right talents and abilities to enter this field. Finding alternatives to both the short-term and the long-term skill shortage problem will remain a challenge for the foreseeable future.

Rapid change and growing complexity/ specialization in the IT industry. The growing complexity and rapid change of this industry makes it increasingly difficult for any one department, school or institution to fulfill the market demand. Conventional curriculum change processes cannot keep pace with much of this technological change. Alternatives to traditional curriculum delivery, program planning, and credentialling need to be considered in order to meet these challenges.

Global nature of IT industry. The software industry in B.C. and in most other parts of the world is global in nature. Markets are worldwide and software workers are highly mobile. Increasingly, therefore, training programs for this industry must look beyond local conditions and factor in considerations that are more global and international in scope.

Category	Issues and Concerns
Top 4 Industry Concerns	1. Recruiting quality people 2. Customer satisfaction 3. Delivery schedules 4. Managing growth
Top 3 Software Development Problems	1. Schedule overruns 2. Shortage of skilled staff 3. Poorly defined requirements
Top 4 Technology Change Concerns	1. Internet and information publishing 2. Development tools and languages 3. Client/server & distributed computing 4. Desktop operating systems
Top Software Industry Needs (1996)	1. Written/Verbal Communications 2. C++ 3. NS Windows NT 4. Technical Leadership 5. Team skills

Top Skills Gaps	1. Technical leadership 2. Domain knowledge 3. Object-oriented methods 4. C++ 5. MS Windows NT

Table 6. Technology Needs and Skills Gaps

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Biography

Ken Takagaki

Ken Takagaki is Dean of the School of Computing and Information Technology at the British Columbia Institute of Technology (Canada). Dr. Takagaki received his Ph.D. in Information Systems from the University of British Columbia and has 25 years of experience in the Computing, Software Development and IT industries, both in private industry and the academic sector. He is a member of the Canadian Information Processing Society (CIPS), ACM, and IEEE Computer Society and is also a licensed Certified Accountant. He has ~~been~~ a director of the boards of Software B.C. and the Technology Industries Association of B.C. (TIA-BC), chair of the B.C. Computers in Education Council (BCCEC), and chair of the CIPS National College Accreditation Council. He has been involved in numerous IT related activities for both industry and public sector organizations, including the B.C. Science Council, TIA-BC, CIPS and most recently, the Minister's Task Force on the B.C. Software Industry Skills Shortage.

In his current position, Dr. Takagaki is responsible for the development and delivery of Computing and IT programs at the B.C. Institute of Technology. He has been directly responsible for the development of the Bachelor of Technology (Computer Systems) degree and the Diploma programs in Multi-Media, Technical Programming, Data Communications, Data Base and Client/Server.

USING THE WORLD WIDE WEB IN EDUCATION AND TRAINING

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Introduction

Distance learning is not a new subject, but it recently has come in vogue again. With the advent of new educational and training technologies and the need to meet the needs of students in a fast-paced world, distance learning is becoming a necessity. In its best sense, it can help educate more people anywhere at any time.

Distance learning is a challenge, for those who create the programs and those who participate in them. It offers us the potential to provide ongoing education to more people, but is also requires us carefully to evaluate our instructional methods and the technologies to establish communication among learners and educators/trainers.

Distance learning can be much more than this simple definition indicates. It can involve the use of new technologies, innovative materials, and interactive instructional methods. It can reach people of all ages and abilities who might otherwise find it difficult to further their education or get the training they need. It can help students realize the importance of lifelong education, whether for personal interest or career preparation and enhancement. Distance learning is not a panacea for all educational or training ills, but it does offer additional possibilities for educating and training more people than can be easily and efficiently accommodated in more traditional settings, such as in-house corporate training programs, public schools, and universities. In the broadest sense, distance learning can be very private or it can be highly formalized.

The Internet and the World Wide Web

With the constantly increasing popularity of the internet, distance learning has taken on new meaning. The Internet is an international network that links one computer to another. Unlike a LAN, the Internet is a wide area network (WAN), one so large that virtually any computer anywhere in the world can be linked to others.

Once learners have subscribed to, or signed up for, an Internet provider, they gain access to the educational materials and services designed for the Internet and World Wide Web (WWW), E-mail, or electronic mail, allows one person to write messages to an individual or a group; this tool can be used to update the "correspondence" part of the correspondence courses. Electronic bulletin boards and mailing lists link individuals to more information and other people interested in similar topics. Online chat rooms promote discussions. Very simply, primarily written communication tools can enhance distance learning programs.

Perhaps the most exciting part of the Internet is its multimedia and hypertext capabilities. The Web provides information in many different formats. Of course, text is still a popular way to transmit information, but the Web also presents information in sound bites, such as music, voice, or special effects. Graphics may be still photographs, drawings, cartoons, diagrams, tables or other artwork, but they also may be moving, such as animation or video.

Because of the interactive, multimedia capabilities of the Internet, and especially the Web, distance learning is gaining popularity with new groups of learners, educators, and trainers. Educational and training materials can be stored on a Web site so that learners anywhere have access to the information at any time. There is a greater potential for sharing information through the Internet than through other means of transmitting and receiving information.

When the Internet is used in distance learning courses, learners can also gain that personal touch by sending e-mail messages to their instructor or to other learners. Chat rooms and mailing lists can connect groups of learners to discuss a topic and share ideas. Assignments can be sent electronically instead through the mail and feedback can be provided more quickly. Materials from learners can be added to the Web site to share with others taking the same course and new information can be added quickly to the Web site.

Internet-based education overcomes the stumbling blocks of time and distance. The internet is opening new ways of studying, allowing schools to become "virtual universities". It gives student remote access to research and study materials. Online education holds an irresistible appeal on three fronts: convenience, encourages active learning, access to wide cultural and knowledge base of faculty and students. Interacting with virtual classmates and lecturers in remote locations with different time zones, forces one to be creative and thoughtful. Students assert that taking part in an Internet-based course program engenders a higher set of skills, particularly the ability to communicate and respond in real-time.

Informatics1

Informatics through its team of R & D professionals began exploring the use of the Internet to enable group-based reporting, discussion, workshops and dissemination of course materials. The company is currently developing its Internet Online Services titled *Informatics1* for students and to provide learning accessible anytime and anywhere. It will be an innovative approach that provides distance learning programs to the growing audio-visual presentation industry - it effectively overcomes the limitations of time and travel. Moreover it will keep students' attention to this dynamic learning environment.

Informatics1 is a world class Cyber Campus of tremendous magnitude. It consists of various state-of-the-art components such as video conferencing, automated online test, mock exams, resources, chat-rooms for group discussions and others that provide a true interactive environment for users as well as for our students.

Because today's students often have full-time jobs while pursuing professional and personal development, working and learning are no longer mutually exclusive activities, *Informatics1* incorporates the richness of group learning with the flexibility support individual learning, all enabled by collaborative technologies. It is an unique approach that allows new and rich forms of education to be offered by corporations and higher education institutions to a diverse and distributed population of learners. Distributed learning uniquely responds to the needs of these learners for flexible, collaborative learning which can be accessed anytime and anywhere through distance learning.

Changes in technology have spawned new ways of working, new business processes, and new ways of delivering education. Within the context of rapid technological change, training and education is seen as an ongoing necessity, enabling workers to remain current with required skills and knowledge.

A number of underlying social, economic and technological forces are coming together to drive demand for continuing education and training.

While individuals are motivated to learn from personal and professional development, the logistics of attending classroom education are increasingly difficult to manage. To respond to this situation, Informatics are looking to:

- Increase the speed, flexibility and reach of training and education
- Reduce costs associated with offering classroom training as the only delivery vehicle.
- Leverage instructors' expertise to a broader population of participants.
- Leverage team learning and collaboration for performance and productivity.

The growing market for continuing education and the market conditions described above have fueled the growth of "distance learning" options. These new modes of learning are designed to meet the demand for continuing education while providing a range of flexible delivery choices.

To stretch dollars, Informatics is turning to technology for assistance in distributing more flexible educational experiences. Technology can deliver learning experiences directly to learners desks or workstations, eliminating travel and related expenses. Learning becomes available when as learners need it, not merely when it is scheduled.

The cost of technology has at times prohibited widespread use of distance learning, but recent reductions in the cost of hardware and software have lowered that barrier. The huge growth in the installed base of networked and inter-networked computers presents an opportunity now to create an electronic environment for learning any time and any place by Informatics.

Creating a Virtual Classroom within *Informatics1*

A virtual classroom should not be much different from a real classroom or training room. An effective classroom does the following:

- It provides the tools that learners need when they need them. If it's not possible to have all the tools in the classroom, an effective educator/trainer explains where the tools can be easily located.
- It creates an expectation for and an environment conductive to learning.
- It brings together educators/trainers and learners to share information and exchange ideas.
- It allows learners the freedom to experiment, test their knowledge, practice completing tasks, and apply what they've discussed or read about.
- It provides mechanisms for evaluating performance.
- It provides a safe haven in which learning can take place.

Providing Tools for Learners

The virtual classroom must contain the tools needed for the course and the ability to receive and send information among learners and educators/trainers. For example, if learners will read documents, the documents should be accessed online from the Web site. If learners need additional documents that can't be placed online within the course's Web site, educators/trainers must provide links to other sites where the information is stored.

Taking a distance learning course in Iformatics1 which involves a teleconference, any materials referenced during the teleconference should have send to learners seeing the teleconference from another site. The teleconference room itself must be equipped with the necessary technology to make sure that all learners, whether in a remote location or at the originating site of the teleconference, can receive all the information.

Creating an Expectation for Learning

Distance learning courses can be as difficult, important, and effective as in-person classes or training sessions. But to receive the same status as in-person courses, distance learning classrooms like those found in *Informatics1* must create within learners and educators/trainers the same expectation that learning will occur and that the course is serious business. "Serious" doesn't mean dull or uninteresting; it does mean that learners will complete the course work and meet their responsibilities with the same intensity that they would in a regular classroom. Educators/trainers treat the distance learning course with the same amount of preparation and treat individual learners with the same degree of courtesy and interest that they would in a regular classroom.

Setting course objectives, explaining the purpose and design of the course, developing high-quality materials, and making sure that learners and educators/trainers can communicate with each other at certain points in the course are important ways of creating an expectation for learning.

Bringing Together Learners and Educators/Trainers

Learners and educators/trainers may seldom (or never)see each other during the course; they may never have the opportunity to meet in person. Nevertheless, an effective classroom is the place where learners and educators/trainers create a community of sharing. Writing e-mail messages back and forth can establish a personal link among participants in a course, as can participation in a mailing list, a newsgroup, pr a multiple-user domain (MUD). Through a teleconference or a desktop video conference, participants can see and/or hear and/or speak with each other, to create a more personal form of communication.

When educators/trainers use more than one medium to create a virtual classroom, the sense of community among learner and instructors is enhanced. The more ways to communicate with each other and develop a sense of the people behind the programs, the more personal the education or training.

Creating the Space for Experimentation and Application

Education and training involve more than listening to someone talk about subject or reading and discussing materials. Theoretical background is important, but so is application. In effective classrooms, learners have the opportunity to apply what they learn. In a regular classroom, they may complete workshop activities, conduct an experiment in a lab, demonstrate the correct way to complete a task, or make a group presentation to express their ideas.

The virtual classroom should be designed to allow learners similar types of practice and sharing activities. For example, a teleconference or a desktop video conference can be used for group or individual) speeches and presentations. An online simulation, with appropriately designed feedback for acceptable and incorrect actions or choices, can allow participants to act out what they've learned, role play, conduct an experiment, or complete a task.

Virtual classrooms should provide activities as well as referential information. They should help learners develop both skills and knowledge appropriate to the course.

Evaluating Performance

In addition to the immediate feedback provided through simulations, for example, other ways of evaluating learners' performance should be built into the course. The classroom environment within *Informatics1* include sites where learners can ask questions and receive answers, take practice or real examination and receive comments about the accuracy of their responses, and otherwise measure how well learners are doing. Some forms of feedback can be very personal; educators/trainers may write e-mail messages, add comments to assignments and return them to learner, discuss performance on the phone or during a teleconference or video conference, and so on. Whatever evaluation methods are included in the course design, learners should always have an objective measure of their progress.

Creating a Safe Haven

Learners need the freedom to experiment, to make incorrect assumptions and choices, to success and showcase what they've learned, and to interact with others, free of anxiety. An effect classroom is the place where learners feel free to express themselves in appropriate ways, to take risks so that they can learn more, to share their ideas, and to ask questions. The virtual classroom can provide the safe haven for learners to interact with each other and take the risks they need to learn more. It should allow them the opportunity to question instructors and other learners, and to test their ideas and skills in non-threatening ways.

Educators/trainers who develop a virtual classroom can create a "safe" atmosphere in several ways. They can establish protocols for using the technology (e.g. providing equal access to resources, ensuring that no one can tamper with another learner's or the educators'/trainers' materials) and for communicating with each other. Through their instructional materials, educators/trainers can encourage questions and comments. Creating a safe haven involves establishing and maintaining professionalism among all the course's participants and valuing the contributions of each member of the virtual class.

Who participants in distance learning through *Informatics1*?

Participants in distance learning through Informatics include the people who create and disseminate the learning materials and the students.

Distance learning is even more important today, when society is changing rapidly. Students need to meet ongoing needs for education and training. As society becomes technologically more sophisticated, the knowledge base changes; what is considered a "well-rounded education" changes with and expanded knowledge base.

Learners who take distance learning courses

Adults whose work and personal schedules don't permit them to attend classes scheduled by a university in their area can take distance learning courses offered within *Informatics1* at their convenience. Adults or youth who suffer from a temporary or permanent illness or condition that prevents them from participating in other types of education programs can receive similar instruction at home or in another setting. People with different abilities, which may make it difficult to participate at the same pace or in the same way as other students in a classroom, may participate fully by using specially designed materials that enhance their learning. In short, distance learning can be an effective method of education or training. In short, distance learning can be an effective method of education and training for almost everyone. It promotes the sharing of information and experiences, so that people who design and provide the materials and the people who use them can learn from each other.

What are the benefits of distance learning on *Informatics1*?

Learn at their own pace

Learners can take a course during a traditional term or training sessions, or they can take their time to complete learning activities. They can go over materials many times or proceed quickly and use materials during the day, after work, during breaks, in the middle of the night, or at regularly scheduled intervals- whenever is convenient for them and the provider of the information. They can learn during predetermined time segments (such as an hour-long discussion or a 15-minute teleconference) or participate for as long or as little as they need, for as many times as is appropriate for them to gather information or master a skill or concept.

Learn in a Convenient Location

Depending upon the medium or media being used to provide materials or experiences, distance learning can take place in many convenient locations. Learners at home or at work can access *Informatics1* web-based information. This form of distance learning media helps to ensure that people who want to take a course can take one conveniently, wherever they are located. Because distance learning spans many technologies that can reach virtually nearly everyone in the world, learners may find that anyplace can be a learning environment.

Participate in the programs of universities, colleges and other groups that offer high-quality programs without having to relocate.

Within each discipline or profession, some institutions are noted for their high-quality training or educational programs. Participating in high-quality, specialized programs through distance learning can enhance learners' professional standing and provide them with exactly the type of training or education they'll need on the job.

Learners who want to "attend" an university whose name is instantly recognized as a prestigious institution now can take at least some courses without having to relocate near the institution. For example, learners who want to take a course from University of Leicester may be able to participate through courses offered on *Informatics1*.

Learn according to learners' preference mode of learning

Everyone has a learning preference. Some people are active learners, while others are more passive. One benefit of *Informatics1* is the variety of materials available to meet everyone's learning preference.

Some people are hands-on learners, who learn best by doing, Hands-on learners might prefer using online, CD, or interactive video simulations of tasks they'll need to complete later. Virtual reality may be a big part of their educational experience.

Some people learn best by discussing their ideas with peers, to sort through the information and get feedback from other people. Discussion (chat-rooms) and news group probably will be preferred by learners who need to discuss their ideas or findings within a group. These learners might enjoy e-mail, as well as teleconferences or inactive broadcasts over the Internet, to help discuss materials with others.

Other, more traditional learners may prefer lecture and notetaking methods for learning. They may prefer to read and think about material before applying it, and prefer to work with an instructor who provides lectures, notes, handouts, and reading assignments. These group of learners participate in teleconferences, read information stored on Internet, search resource databases online and download their assignments to a printer.

For learners who prefer graphics to prose, the Internet, as well as video, offers a wealth of diverse materials. Movie clips, animation, sound effects, music, voiceovers, photos and 3-D environments are some formats through which they might learn best.

The degree of interactivity required by individual learners can be matched with the type of technology and course. Some media are more interactive, and some subject areas require more direct learner involvement. Distance learning courses, such as that offered on *Informatics1*, if they're well designed, offer learners a wide range of options, so that they can find the right mix of interaction and learning style to enhance their individual capacity to learn or be trained.

Practice working with different technologies

As learners work with *Informatics1* educational technologies, they not only learn about their subject areas, but also have practice working with a variety of interactive technologies. They become fluent with rapidly changing technical environment and receive a broader picture of the many media and technologies that are used to provide them with materials and learning experiences. One of the great benefits of distance learning through *Informatics1* is that learners not only gather information and experiences relating to their primary area of study, but also pick up additional skills and knowledge related to the technology.

Direct their learning

One of the most important benefits may be that learners can direct their learning. As learners have more materials made available to them in exciting, innovative ways, they're more likely to want to learn more and learn on their own. Instead of having an instructor tell them where to access information, what to do, learners are more likely to share with instructors what they've found and how much information is available. They're also more likely to continue their education and training on their own through *Informatics1*.

Conclusion

Today, the quality of distance education depends on technology. Recently improvements in the costs and capabilities of hardware and software, combined with the growth of the World Wide Web and connectivity, encourage the development of new teaching environments. To provide a flexible, collaborative learning experience requires tools that allow learners to access various sources of information in a variety of media and work at their convenience.

Distributed learning allows students to manage their time and learn while interacting with other students and instructors. Students are now presented with new opportunities for professional and personal development.

We believe *Informatics1* and its vast potential services in the near future are significant steps towards realizing Informatics' commitment to current and new customers and learners. These are first steps as we pursue partnerships with institutions of higher education to achieve the shared vision of enabling learning through technology.

Informatics acknowledge that these students within *Informatics1* would be an entire breed of people operating in a global, multimedia world where convenience, accessibility, and real time response are the norm. Such an environment has considerably increased the importance of international business relationships, team-based processes, and networking.

A dedicated team of professionals from Academical, Technical and Business will support the site and provide the online "live" contents. Informatics will further develop Internet resources to reduce operational cost, improve productively and better learner's services & training.

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